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pleasant hours with the polypods and will undoubtedly be rewarded by finding of one or more forms, not mentioning the many freaks that will be constantly appearing before him.

HIRAM, MAINE.

FERN LEAVES, FERNS AND FERN ALLIES

R. C. BENEDICT

The topic would scarcely seem to be one in need of much discussion, but as morphologists and palæobotanists have lately added a good deal to our knowledge of the subject, completely changing some of the old conceptions, a brief resumé will not be out of place.

There has been a large amount written about ferns in the last few years, particularly about their anatomy and evolution,—and consequently about their relationships to other groups of plants, such as the lycopods, equisetes, cycads, flowering plants, etc. Taking pteridophytes as a whole, the number of printed pages devoted to this collection of plants in the last five years is in the thousands,—and this estimate does not include taxonomic literature. Among those who have contributed largely on this topic are Professor Bower of the University of Glasgow, Professor Jeffreys of Harvard, Professor Scott of Cambridge, and Professor Campbell of Leland Stanford.

These and a large number of others have expressed no doubt as to the distinction between leaf and stem in our modern ferns. A fern leaf is a lateral appendage of a fern stem, and has three main characteristics: (1)

It is rolled in a coil in the bud phase; (2) as it unrolls the apex continues to grow; this power of more or less indefinite growth is possessed most remarkably by *Lygodium* and the *Gleicheniaceæ*. Campbell refers to leaves of *Lygodium* which reach a length of one hundred feet, and in the *Gleicheniaceæ* the leaf apex may continue to unroll for several seasons; (3) fern leaves bear sporangia on the back.

Ferns then are pteridophytes with leaves of the type just described.

Fern allies should be, as the word "allies" implies, related to ferns. Relationship, as ordinarily determined in such cases, depends on (a) similarity of structure, and (b) actual relationship as shown by study of fossils.

According to structure, lycopods and equisetes, often called "fern allies," are not related to ferns at all. It is necessary only to point to the difference between their leaves and the leaves of ferns, and to the fact that their sporangia are borne either on the upper surface of the leaves, or on the stem itself. The internal anatomy is also different.

Neither according to the geological evidence, do ferns, lycopods, and equisetes show any inter-relationship. In the earliest horizons in which fossils of vascular plants are found these three groups occur, and differ in the same respects as today. This earliest period is estimated to be as much as sixty million years old.

However, a certain group of plants, alive at that time but extinct now, is of especial interest in determining what are fern allies. These were plants with leaves very much like fern leaves, so much so that until recently most of them were believed to be ferns. It has been found, however, that these plants bore seeds on some of the leaves. On other leaves they bore spores, contained in *spore cases* and *fruit-dots*, but these spores were the *pollen grains*.

Because of the many striking resemblances to ferns, it is believed that these "seed ferns," or pteridosperms, as they are called, were directly descended from plants ancestral also to the true ferns. The cycads or "fern palms" of our modern tropics, commonly included in the group *Gymnospermæ*, are generally recognized as descendants of the pteridosperms. This opens up a new line of fern allies, nearer at least than *Equisetum* and *Lycopodium*.

But a still greater line of "allies" will have to be recognized if recent researches of G. R. Wieland on Mexican cycads are confirmed. He has found among certain Mesozoic cycads a type of floral structure so much like certain modern angiospermous types that he has concluded that our common flowering plants must be descended from the cycad-fern line.

No one, however, is likely to include flowering plants under the title of fern allies. This name may be properly applied to three modern groups of plants, viz., the *Ophioglossales*, the *Salviniaceæ* and the *Marsiliaceæ*, the last two groups being often grouped together as the *Hydropterides*, or water ferns, but now believed to be related to separate lines of ferns.

The *Ophioglossales* have given rise to a large amount of discussion as to the exact nature of the fertile spike or panicle. Campbell at one time believed it to be primitive, and suggested that it might show a relationship with the liverwort *Anthoceros*. He has since withdrawn from that position. Bower believes these plants to be related to the *Equisetum* line, in which case they would not be fern allies, of course.

Probably, however, the most generally accepted view regards them as allied to ferns, and a recent paper by Chrysler (Bot. Gaz., 43:1909), in which evidence is given to prove that the fertile part represents fused pinnæ, furnishes strong support for this opinion. There

is certainly no justification for comparing the leaves of these plants to the stems, leaves, and flowers of a peony.

It will be seen, then, that a magazine devoted to ferns, lycopods, and equisetes, can hardly be said to be devoted to one group of plants, and this distinction will have to be reserved for the four or five fungus periodicals, and the French bryophyte journal, the *Revue Bryologique*.

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NOTES ON SOME FERNS FOUND DURING 1909

PHILIP DOWELL

While attending the botanical symposium, at Stamford, New York, during the first week of July, 1909, I was interested chiefly in noting and collecting some of the ferns of the region. Beside the more common ferns and some that are noted further on, I may here mention the following as found in the region: *Phegopteris Dryopteris* (L.) Fée, *P. Phegopteris* (L.) Und., *Filix fragilis* (L.) Und., *Matteuccia Struthiopteris* (L.) Todaro, *Dryopteris cristata* x *marginalis* Dav. About midway up Mt. Utsayantha there were a few plants of *Athyrium angustifolium* (Michx.) Milde growing in an open wet place. I did not see this fern elsewhere in the region about Stamford. Near the summit of the mountain there were *Dryopteris Goldiana* (Hook.) Gray, *D. dilatata* (Hoffm.) Gray, and *D. intermedia* (Muhl.) Gray. The two latter grew side by side, and I made a hurried but unsuccessful search for intermediates between them. On the wooded slopes of this mountain and of Bald Hill there were numerous little plants of *Botrychium lanceolatum* (Gmel.) Ångstr. and *B. neglectum* Wood. These